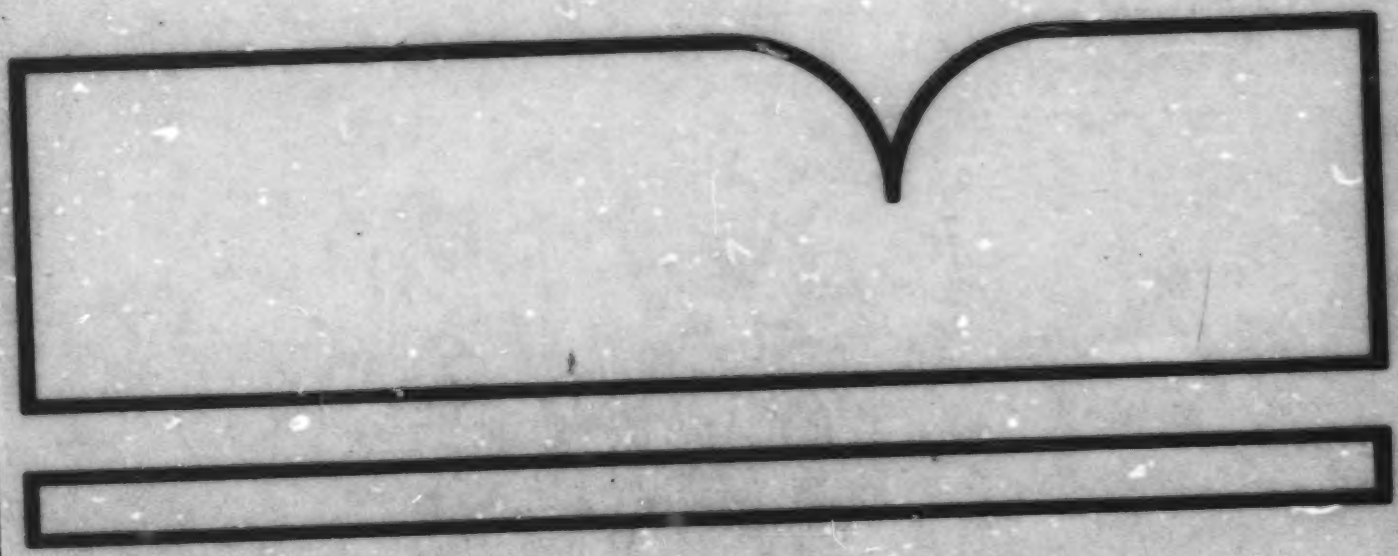
PB81-172561

Radioactivity Standards Distribution Program Fiscal Year 1981-1982

(U.S.) Environmental Monitoring Systems Lab.
Las Vegas, NV

Oct 80



U.S. Department of Commerce
National Technical Information Service
NTIS

United States
Environmental Protection
Agency

Environmental Monitoring
Systems Laboratory
P.O. Box 15027
Las Vegas NV 89114

EPA-600/4-80-044
October 1980

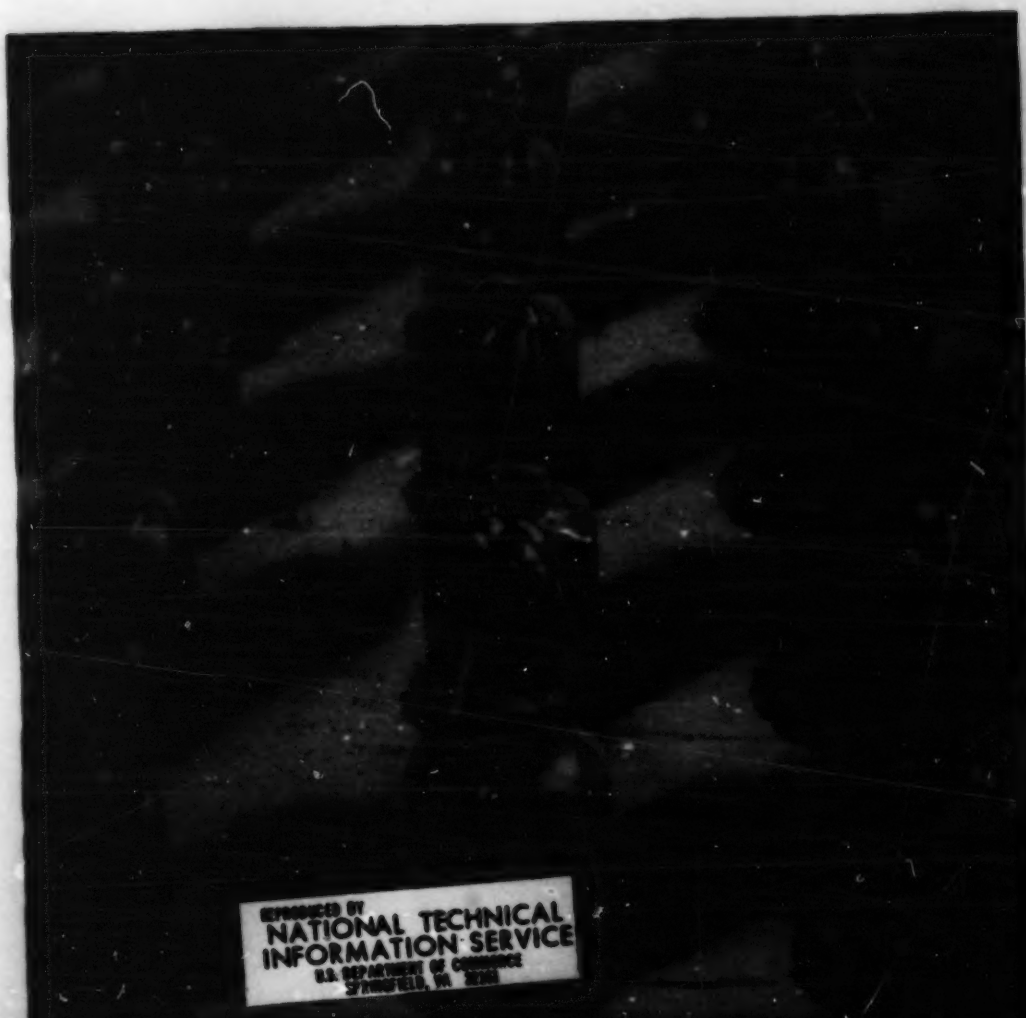
PB81-172561

Research and Development

EPA

Radioactivity Standards Distribution Program Fiscal Year 1981-1982

prepared for the
Office of Drinking Water
and
Office of Radiation Programs



REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA 22161

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-600/4-80-044	2.
3. RECIPIENT'S ACCESSION NO. PB81 172561	
4. TITLE AND SUBTITLE RADIOACTIVITY STANDARDS DISTRIBUTION PROGRAM, Fiscal Year 1981-1982	5. REPORT DATE October 1980 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Loren E. Thompson, Quality Assurance Division	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Environmental Monitoring Systems Laboratory Office of Research and Development U.S. Environmental Protection Agency Las Vegas, Nevada 89114	10. PROGRAM ELEMENT NO. A6ZC1D/A7WF1D/A39B1D 11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS U.S. Environmental Protection Agency--Las Vegas, NV Office of Research and Development Environmental Monitoring Systems Laboratory Las Vegas, Nevada 89114	13. TYPE OF REPORT AND PERIOD COVERED interim (1981-1982) 14. SPONSORING AGENCY CODE EPA/600/07
15. SUPPLEMENTARY NOTES	

16. ABSTRACT

A program for the distribution of calibrated radioactive samples, as one function of EPA's quality assurance program for enviornmental radiation measurements, is described. Included is a discussion of the objectives of the distribution program and a description of the preparation, availability, and distribution of calibrated radioactive samples. Instructions and application forms are included for laboratories desiring to participate in the program.

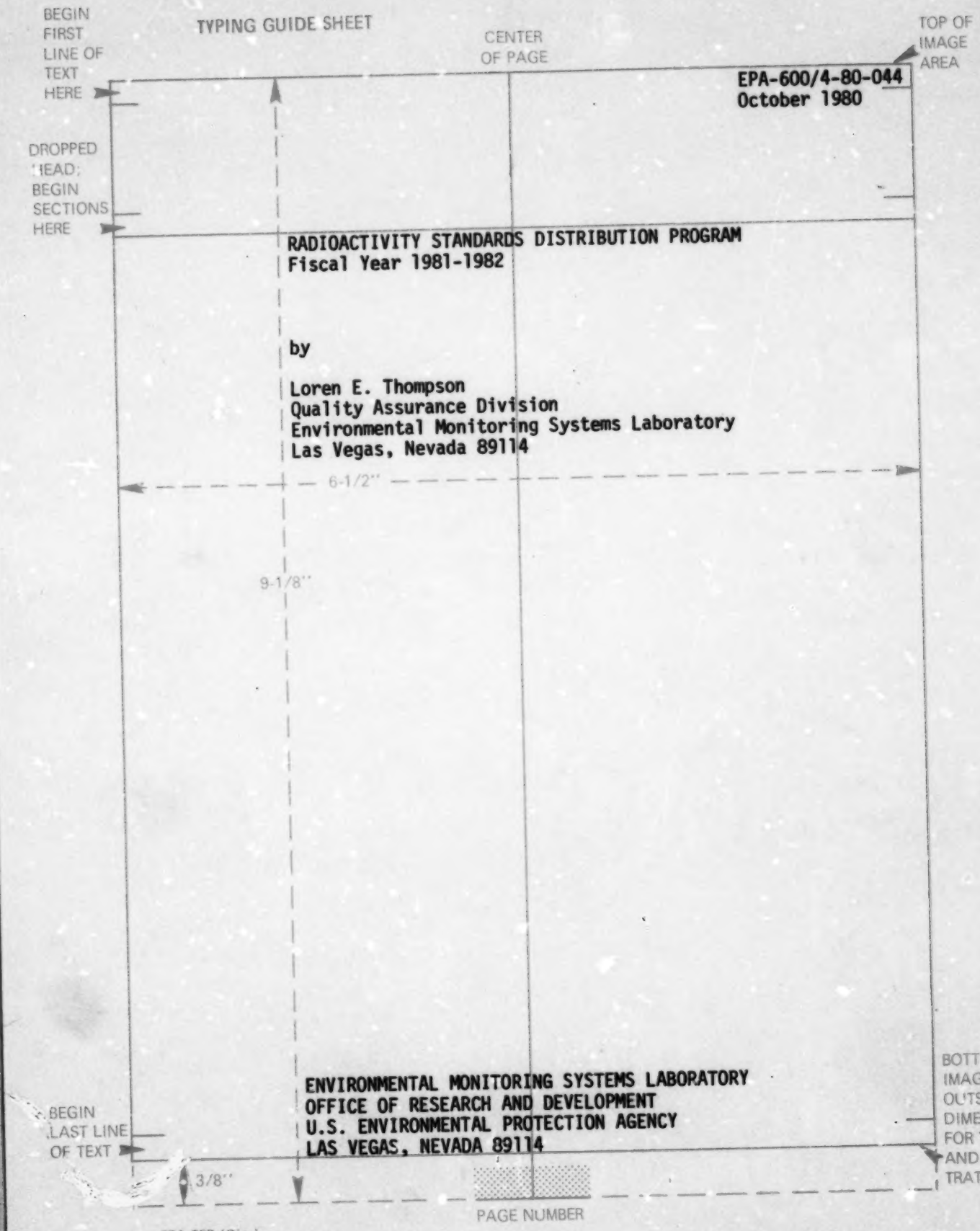
This document is not a research report. It is designed for use by personnel of laboratories participating or desiring to participate in the Radioactivity Standards Distribution Program, which is a part of the U.S. Environmental Protection Agency's quality assurance program.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Quality assurance Quality control Radioactivity Quantitative analysis Calibrating Standards		07 B 14 B, D 18 H

18. DISTRIBUTION STATEMENT RELEASE TO PUBLIC	19. SECURITY CLASS *(This Report)* UNCLASSIFIED	21. NO. OF PAGES
	20. SECURITY CLASS *(This page)* UNCLASSIFIED	22. PRICE

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE


BEGIN FIRST LINE OF TEXT HERE
TYPING GUIDE SHEET
CENTER OF PAGE
TOP OF IMAGE AREA
EPA-600/4-80-044
October 1980
DROPPED HEAD; BEGIN SECTIONS HERE
RADIOACTIVITY STANDARDS DISTRIBUTION PROGRAM
Fiscal Year 1981-1982
by
Loren E. Thompson
Quality Assurance Division
Environmental Monitoring Systems Laboratory
Las Vegas, Nevada 89114
6-1/2"
9-1/8"
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
LAS VEGAS, NEVADA 89114
BOTTOM OF IMAGE AREA; OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
BEGIN LAST LINE OF TEXT
3/8"
PAGE NUMBER
EPA-287 (Cin.)
(4-76)

BEGIN FIRST LINE OF TEXT HERE
TYPING GUIDE SHEET
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEAD: BEGIN SECTIONS HERE

FOREWORD

This document, which is essentially a catalog, describes the types and concentrations of calibrated radioactivity samples available from EPA's Environmental Monitoring Systems Laboratory in Las Vegas. It indicates the results of traceability studies linked to the National Bureau of Standards and provides forms for requesting the standard samples.

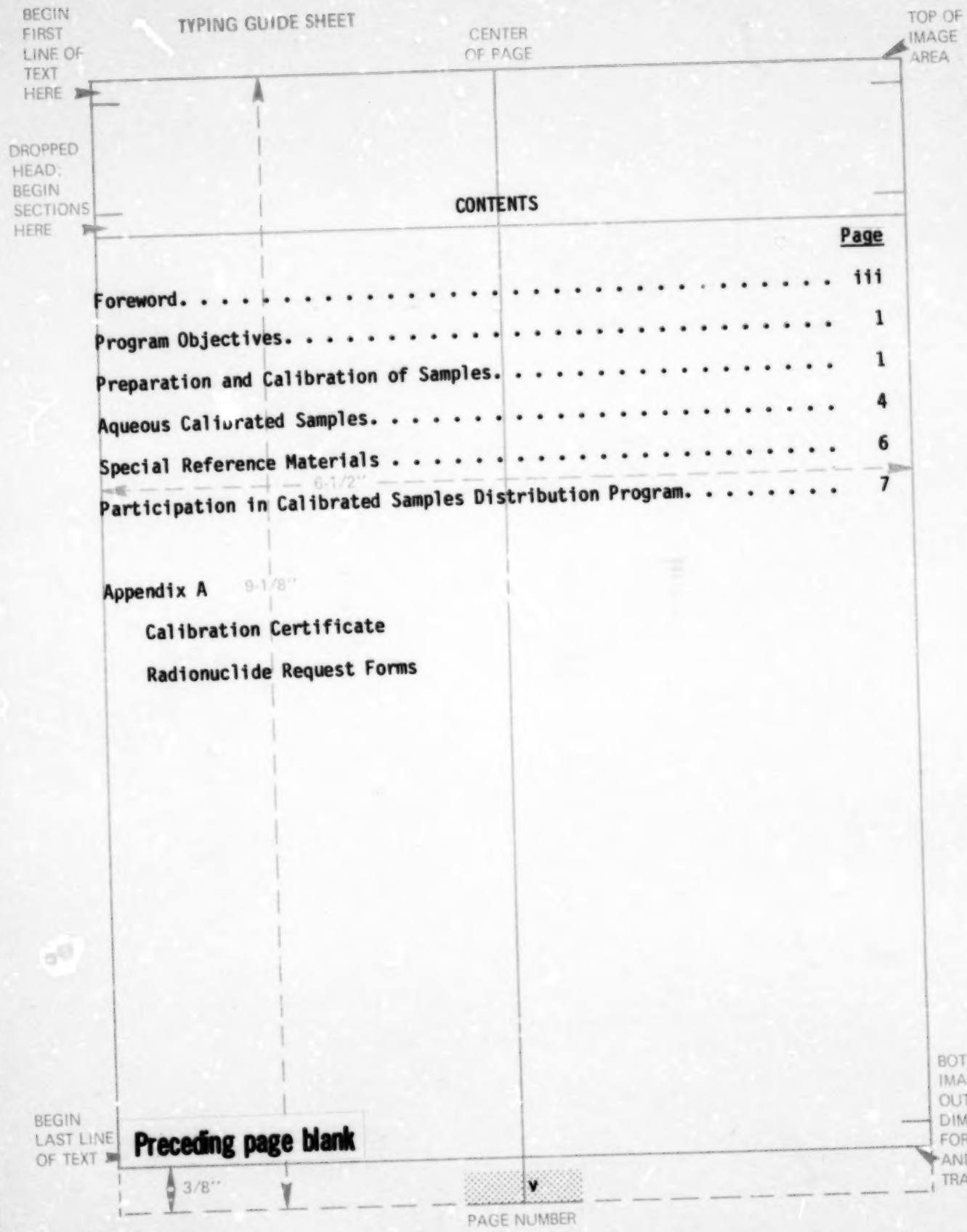
The catalog is distributed to over 200 laboratories (Regional, State, nuclear facility, National, commercial, and international) that are involved in environmental radiation measurements. These laboratories, and any others that wish to participate in EPA's quality assurance program for radiation measurements, are encouraged to use the standards and the reference materials described in this catalog for calibrating instrumentation, for verification of analytical methodology, and for quality control.

9-1/8"

Glenn E. Schweitzer
Director
Environmental Monitoring Systems Laboratory
Las Vegas, Nevada

BOTTOM OF IMAGE AREA: OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
BEGIN LAST LINE OF TEXT
3/8"

EPA-287 (Cin.)
(4-76)


BEGIN FIRST LINE OF TEXT HERE
TYPING GUIDE SHEET
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEAD; BEGIN SECTIONS HERE
CONTENTS
Page
Foreword. iii
Program Objectives. 1
Preparation and Calibration of Samples. 1
Aqueous Calibrated Samples. 4
Special Reference Materials 6
6-1/2"
Participation in Calibrated Samples Distribution Program. 7
Appendix A
9-1/8"
Calibration Certificate
Radionuclide Request Forms
BOTTOM OF IMAGE AREA; OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
BEGIN LAST LINE OF TEXT
Preceding page blank
3/8"
v
PAGE NUMBER
EPA-287 (Cin.)
(4-76)

BEGIN FIRST LINE OF TEXT HERE
TYPING GUIDE SHEET
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEAD: BEGIN SECTIONS HERE

PROGRAM OBJECTIVES

Environmental measurements are made daily by many different Federal, State, local and private agencies. The data from these measurements are used for a wide variety of purposes including assessment of health effects, establishment of standards and guides, and for enforcement activities. It is, therefore, imperative that the precision and accuracy of the data be assured in order that policy decisions concerning environmental quality be based on valid and comparable data.

The quality assurance program of the U.S. Environmental Protection Agency (EPA) is designed to encourage the development and implementation of quality control procedures at all levels of sample collection, analysis, data handling, and reporting. Quality assurance responsibilities, in the radiation area, have been assigned to the Quality Assurance Division at the EPA's Environmental Monitoring Systems Laboratory in Las Vegas. This Division, as an integral part of its overall quality assurance effort, prepares and distributes a variety of calibrated low-level radioactive samples for use in the laboratories of Federal, State, and local agencies.

The major objective of this program is to encourage the development of intralaboratory and interlaboratory quality control procedures and thus help ensure that environmental radiation data are valid. Accurately calibrated samples furnished by EMSL-LV are used by laboratories in calibrating new instruments, implementing and maintaining routine instrument calibration programs, evaluating analytical procedures, and developing and revising data processing programs.

The following pages briefly describe how standards are prepared, list the radionuclides available, and indicate how a laboratory may acquire standards from the EMSL-LV.

If your laboratory does not currently use the services provided by the Quality Assurance Division at the EMSL-LV, it is encouraged to do so.

PREPARATION AND CALIBRATION OF SAMPLES

The radionuclides used in preparing calibrated samples are obtained from the National Bureau of Standards, Laboratorie de Metrologie des Rayonnements Ionisants (France), or from other reliable commercial sources. The uncertainty in the known activity of individual sources ranges from 0.5 to 5 percent. The activity of radionuclide impurities, excluding daughters, is

BEGIN LAST LINE OF TEXT
BOTTOM OF IMAGE AREA; OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
3/8"

EPA-287 (Cin.)
(4-76)

BEGIN FIRST LINE OF TEXT HERE
TYPING GUIDE SHEET
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEAD; BEGIN SECTIONS HERE

documented and typically is less than 1 percent of the activity of the principal radionuclide at the time of sample preparation.

Upon receipt at EMSL-LV, a radionuclide is checked for its activity and for the presence of radioactive contaminants. The sample is then diluted to the desired activity level with a carrier of the same chemical composition as used by the supplier. In certain cases, the addition of a stabilizer is required. The accuracy of the dilution is carefully checked and aliquots of the solution are flame-sealed in 5-milliliter glass ampuls.

Accompanying the shipment of each calibrated sample is a certificate listing pertinent information concerning the sample and its calibration, including an estimate of the errors associated with the value of the activity (Appendix A). For gamma emitters, a plot of the net pulse height spectrum is also included.

To further assure the precision and accuracy of the calibrated samples, the Quality Assurance Division participates in an ongoing intercomparison study with the National Bureau of Standards (NBS). Definitions of traceability to the national radioactivity measurement system are described in an article written by Cavallo et al. (K. Siegbahn, ed., Nuclear Instruments and Methods, Vol. 112. No. 1, 2. Sept./Oct. 1973. p. 5). In this article it is stated:

> "Direct traceability to the national radioactivity measurement system (NRMS) exists when any 'outside' laboratory prepares a batch of calibrated radioactivity standards and submits several randomly selected samples to the national standardizing laboratory for confirmation and verification... Indirect traceability to the NRMS exists when the national laboratory provides 'unknown' calibrated radioactivity samples to one or more measurement laboratories, who in turn make measurements of activity that agree within certain specified limits with those of the national laboratory. Thus we can have 1%, 5%, etc., traceability... Indirect traceability only means that the 'lower level' laboratory has the potential to make measurements that are consistent within the NRMS..."

Table 1 lists the results of the EPA's traceability program with the NBS. Shown in each category of direct or indirect traceability is a nuclide and the ratio of the activity measured by EPA to the activity measured by the NBS. In the section on direct traceability, each nuclide is a 5 ml ampul of a radioactive solution taken from the EPA radionuclide inventory and sent to the NBS for analysis at various times.

BEGIN LAST LINE OF TEXT
BOTTOM OF IMAGE AREA; OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
3/8"

EPA-287 (Cin.)
(4-76)

BEGIN FIRST LINE OF TEXT HERE
TYPING GUIDE SHEET
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEAD; BEGIN SECTIONS HERE
6-1/2"
9-1/8"
BEGIN LAST LINE OF TEXT
3/8"
BOTTOM OF IMAGE AREA OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
PAGE NUMBER
EPA-287 (Cin.)
(4-76)

TABLE 1. RATIOS OF ACTIVITY MEASUREMENTS PERFORMED UNDER THE EPA TRACEABILITY PROGRAM WITH NBS, JANUARY 1974 TO JANUARY 1980

	Nuclide	EPA Value / NBS Value
Direct traceability:		
Samples submitted to NBS by the EMSL-LV	^{3}H	0.995
	^{51}Cr	0.985
	^{54}Mn	0.997
	^{60}Co	1.006
	^{65}Zn	0.994
	^{89}Sr	0.989
	^{89}Sr	0.956
	^{89}Sr	0.977
	^{90}Sr	1.024
	^{131}I	0.977
Indirect traceability:		
NBS-prepared samples sent to the EMSL-LV	^{14}C	1.004
	^{45}Ca	1.049
	^{46}Sc	0.995
	^{51}Cr	1.015
	^{59}Fe	0.996
	^{57}Co	1.027
	^{58}Co	0.960
	^{60}Co	1.001
	^{63}Ni	0.989
	^{75}Se	0.919
	^{89}Sr	0.997
	^{90}Sr	1.008
	^{99}Mo	0.958
	^{109}Cd	0.970
	^{110m}Ag	1.018
	^{134}Cs	1.013
	^{137}Cs	0.981
	^{140}Ba	0.979
	^{141}Ce	1.080
	^{147}Pm	1.008
	^{152}Eu	0.959
	^{203}Hg	1.024
	^{203}Hg	1.017
	^{203}Pb	1.171
	^{228}Th	0.970
	^{238}Pu	1.000
	^{239}Pu	0.986
	^{241}Am	0.995

BEGIN FIRST LINE OF TEXT HERE
TYPING GUIDE SHEET
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEAD; BEGIN SECTIONS HERE

AQUEOUS CALIBRATED SAMPLES

The inventory of calibrated samples consists of a number of calibrated radionuclide solutions (Table 2). Except for Iodine-131, every effort is made to maintain this inventory so that samples can be shipped in a timely manner. Iodine-131 is prepared bimonthly and distributed to requestors on record. While the types of calibrated samples in the inventory vary during the year, every effort is made to keep the calibrated solution samples listed in Table 2 in stock and available for distribution at any time.

TABLE 2. CALIBRATED RADIONUCLIDE SAMPLES KEPT IN INVENTORY

Isotope	Type Emission	Half-Life	Major Gamma Peak (MeV)	% Gamma Abundance	dpm/g*
^{3}H	β-	12.35 y	--	--	10,000
^{14}C	β-	5730 y	--	--	10,000
^{54}Mn	γ	312.5 d	0.835	99.978	40,000
^{57}Co	γ	270.9 d	0.122	85.6	80,000
^{60}Co	β-,γ	5.271 y	1.333	100	40,000
^{63}Ni	β-	92 y	--	--	10,000
^{65}Zn	β+,γ	244.1 d	1.115	50.75	160,000
^{89}Sr	β-	50.6 d	--	--	160,000
^{90}Sr	β-	28 y	--	--	10,000
^{106}Ru	β-,γ	369 d	0.512	20.6	160,000
^{109}Cd	γ	453 d	0.088	3.72	≈0.2 μCi/g
^{110m}Ag	β-,γ	250.8 d	0.658	94.6	80,000
^{125}Sb	β-,γ	2.77 y	0.428	29.6	320,000
^{131}I	β-,γ	8.04 d	0.364	81.2	≈0.4 μCi/g
^{133}Ba	γ	10.5 y	0.356	62.4	160,000
^{134}Cs	β-,γ	2.062 y	0.605	97.6	40,000
^{137}Cs	β-,γ	30.17 y	0.662	85.0	20,000
^{144}Ce	β-,γ	284.3 d	0.134	10.8	320,000
^{226}Ra	α	1600 y	--	--	10,000
†^{228}Ra	β-	5.75 y	--	--	30,000
^{230}Th	α	7.7×10^{4} y	--	--	10,000
†^{232}Th	α	1.4×10^{10} y	--	--	10,000
^{232}U	α	72 y	--	--	25,000
†^{238}U	α	4.5×10^{9} y	--	--	2,500
†^{239}Pu	α	2.4×10^{4} y	--	--	6,000
†^{241}Pu	β-	14.4 y	--	--	10,000
^{241}Am	α	433 y	--	--	10,000

* Approximate activity (dpm/g) of the isotope on the date calibrated.
† Prepared and calibrated by the National Bureau of Standards.

BEGIN LAST LINE OF TEXT
BOTTOM OF IMAGE AREA; OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
3/8"

EPA-287 (Cin.)
(4-76)

BEGIN FIRST LINE OF TEXT HERE
TYPING GUIDE SHEET
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEAD. BEGIN SECTIONS HERE

Throughout the year, the additional radionuclide solutions listed in Table 3 are calibrated and made available for distribution. The Quality Assurance Division will obtain, calibrate, and distribute any of these radionuclides, as time and resources permit, after 10 or more requests have been received. The user is reminded, however, that these solutions are prepared as time permits, and as the Division is able to maintain the above inventory.

TABLE 3. CALIBRATED RADIONUCLIDE SAMPLES SUPPLIED AS NEEDED

Isotope	Type Emission	Half-Life	Major Gamma Peak (MeV)	% Gamma Abundance	dpm/g*
^{7}Be	γ	53.3 d	0.477	10.3	640,000
^{22}Na	β^+,γ	2.602 y	0.511	180.58	20,000
^{46}Sc	β^-,γ	82.80 d	1.120	100	160,000
^{51}Cr	γ	27.704 d	0.320	9.80	~0.2 μCi/g
^{56}Co	β^+,γ	77.3 d	0.847	99.974	160,000
^{58}Co	β^+,γ	70.8 d	0.811	99.45	160,000
^{59}Fe	β^-,γ	44.6 d	1.099	56.1	320,000
^{75}Se	γ	120 d	0.265	59.5	320,000
^{85}Sr	γ	64.85 d	0.514	98.0	160,000
^{88}Y	β^+,γ	107 d	1.836	99.35	160,000
^{95}Zr	β^-,γ	63.98 d	0.757	54.3	320,000
^{103}Ru	γ	39.35 d	0.497	86.4	320,000
^{124}Sb	β^-,γ	60.20 d	0.603	97.9	160,000
^{139}Ce	,γ	137.65 d	0.165	80.0	160,000
^{141}Ce	β^-,γ	32.50 d	0.145	48.0	320,000
^{203}Hg	β^-,γ	46.59 d	0.279	81.5	160,000
^{207}Bi	γ	38 y	0.570	97.8	20,000

* Approximate activity (dpm/g) of the isotope on the date calibrated.

On occasion, a few selected radionuclide solutions not listed in Table 3 are calibrated. Letters will be sent to previous requestors of low-level radionuclide solutions to efficiently allocate the distribution of these solutions.

The primary sources of the listed half-lives are "Nuclear Decay Data for Radionuclides Occurring in Routine Releases from Nuclear Fuel Cycle Facilities", edited by D. C. Kocher (ORNL/NUREG/TM-102, UC-41, Oak Ridge National Laboratory), "Nuclear Decay Data for Selected Radionuclides", edited by M. J. Martin (ORNL-5114, VC-34c -Nuclear Physics, Oak Ridge National Laboratory) and Nuclear Data Tables, Volume A8, Numbers 1, 2, edited by Katherine Way. Half-lives of those radionuclides not listed in any of the above publications were taken from selected volumes of the Nuclear Data Sheets, edited by the Nuclear Data Group.

BEGIN LAST LINE OF TEXT
BOTTOM OF IMAGE AREA, OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
3/8"

EPA-287 (Cin.)
(4-76)

BEGIN FIRST LINE OF TEXT HERE
TYPING GUIDE SHEET
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEAD; BEGIN SECTIONS HERE

SPECIAL REFERENCE MATERIALS

Calibrated soil samples for use as reference materials are also available. These samples have been dried, ground to pass a 170-mesh or a 200-mesh screen, and carefully blended. Reports of calibration accompany the samples. The samples are packaged in glass containers which contain approximately 10 grams (g) of soil. Soils available are:

1. Standard Pitchblende
   Principal radionuclides and approximate activity - ^{238}U : 253 pCi/g; ^{235}U : 12 pCi/g
   Principal daughter products - ^{210}Pb, ^{210}Po, ^{234}U, ^{230}Th, ^{231}Pa, ^{226}Ra, ^{227}Ac, ^{227}Th, ^{214}Pb

2. Diluted Pitchblende
   This is approximately a 10:1 dilution of the standard pitchblende diluted with low-activity soil.

3. Standard Monazite Ore
   Principal radionuclides and approximate activity - ^{232}Th : 1.54 nCi/g; ^{228}Th : 1.54 nCi/g

4. Diluted Monazite Ore
   This is approximately a 10:1 dilution of standard monazite diluted with low-activity soil.

5. Uranium Mill Tailings (1)
   Climax sand tailings
   Principal radionuclides and approximate activity - ^{230}Th : 267 pCi/g; ^{226}Ra : 344 pCi/g; ^{210}Pb : 300 pCi/g

6. Uranium Mill Tailings (2)
   A composite mixture from 16 different uranium mills
   Principal radionuclides and approximate activity - ^{230}Th : 311 pCi/g; ^{226}Ra : 501 pCi/g; ^{210}Pb : 433 pCi/g

7. Diluted Uranium Mill Tailings
   A 7:1 dilution of the Climax sand tailings with low-activity soil.

The three materials listed below were prepared for the EPA by the NBS. Material Number 8 is unspiked. Supplemental information concerning the techniques used to characterize the radium-226 and radium-228 concentrations

BEGIN LAST LINE OF TEXT HERE
BOTTOM OF IMAGE AREA; OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
3/8"

BEGIN FIRST LINE OF TEXT HERE
TYPING GUIDE SHEET
CENTER OF PAGE
TOP OF IMAGE AREA

is supplied with the report of calibration prepared by the NBS. Mancos shale and fly ash are supplied in 100 gram aliquots.

DROPPED HEAD; BEGIN SECTIONS HERE

8. Mancos Shale

Principal radionuclides and approximate activity - ^{226}Ra : 3.4 dpm/g
^{228}Ra : 2.9 dpm/g

9. Fly Ash

Principal radionuclides and approximate activity - ^{226}Ra : 7.8 dpm/g
^{228}Ra : 5.7 dpm/g

10. Mixed Nuclide Standard

A composite mixture of seven radionuclides in an aqueous medium was prepared and calibrated by the National Bureau of Standards. This material is available in 5-milliliter aliquots sealed in a glass ampul. Another mixed nuclide standard is available that is a factor of 10 times greater than the activities listed below.

6-1/2"

Principal radionuclide and approximate activity -

^{3}H	:	14,000 dpm/g
^{90}Sr	:	87 dpm/g
^{134}Cs	:	60 dpm/g
^{226}Ra	:	53 dpm/g
^{228}Ra	:	44 dpm/g
^{234}U	:	73 dpm/g
^{238}U	:	74 dpm/g

9-1/8"

PARTICIPATION IN CALIBRATED SAMPLES DISTRIBUTION PROGRAM

Any Federal, State, local or private laboratories involved in, or concerned with, environmental radiation monitoring and surveillance may participate in the calibrated sample distribution program as long as they are properly licensed to maintain and use radionuclides on their premises. The calibrated materials are shipped on a monthly basis and are available at no cost to the customer. To request standards, complete one of the request forms at the back of this publication, making certain to include the license number, and return the form to:

QUALITY ASSURANCE DIVISION
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY
U.S. ENVIRONMENTAL PROTECTION AGENCY
P. O. Box 15027
Las Vegas, NV 89114

Telephone: (702) 798-2103 Commercial
595-2103 FTS

BOTTOM OF IMAGE AREA; OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
BEGIN LAST LINE OF TEXT
3/8"

EPA-287 (Cin.)
(4-76)

BEGIN FIRST LINE OF TEXT HERE
TYPING GUIDE SHEET
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEAD; BEGIN SECTIONS HERE

APPENDIX A

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory-Las Vegas
Quality Assurance Division

Calibration Certificate

Description

Principal radionuclide: Yttrium-88 — Half-life: 106.6 Days

Nominal activity: 0.387 micro curies

Nominal volume: 5 ml in ampoule/bottle number: 1836-1

Supplied to — Request: 3841

Measurement — Activity of principal radionuclide

Activity per gram of this solution: 77.4 nano curies of Yttrium-88

at 0400 hours PST on April 20, 1978

Activity of daughter radionuclide

The principal activity was accompanied at the quoted time by

[ ] [ ] curies Per gram

of the daughter nuclide [ ]

Total mass of this solution

5.0763 grams

BEGIN LAST LINE OF TEXT
BOTTOM OF IMAGE AREA; OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
Preceding page blank

EPA-287 (Cin.)
(4-76)

BEGIN FIRST LINE OF TEXT HERE
TYPING GUIDE SHEET
CENTER OF PAGE
TOP OF IMAGE AREA

Certificate (continued)

DROPPED HEAD; BEGIN SECTIONS HERE

Method of measurement

The master solution was calibrated with a high resolution gamma ray spectrometer.

The dilution was calibrated by counting in a NaI well detector and calculating the dpm rate by sum-coincidence method.

Useful Life

This radionuclide has decayed through 1.4 half lives since it was obtained by EMSL-LV

We recommend that this solution should not be used after November, 1979

Purity

The manufacturer states that activities other than that of the principal nuclide and of its daughter nuclides, if any, were estimated/known to be:

(1) Other impurities	less than equal to	0.1 %	of the principal activity
(2)	less than equal to	%	of the principal activity
(3)	less than equal to	%	of the principal activity

The activity of impurity (1) is not (2) is not (3) is not included in the quoted figures of the principal activity

It is estimated that we have added the following impurities:

(1)	less than		curies/gram
(2)	less than		curies/gram
(3)	less than		curies/gram

BEGIN LAST LINE OF TEXT
BOTTOM OF IMAGE AREA; OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
3/8"

EPA-287 (Cin.)
(4-76)

BEGIN FIRST LINE OF TEXT HERE
TYPING GUIDE SHEET
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPLD HEAD; BEGIN SECTIONS HERE

Certificate (continued)

Random Errors

The precision of this standard was such that the certified value of the radioactive concentration of the principal activity had a standard error (sm) not greater than ± 2.3 %. (The 99.7% confidence limits are given by t(sm) where t is obtained from the student t factor for the degree of freedom (n-1)).

The maximum uncertainty due to the assessable systematic errors (dilution, counting, and known uncertainty of the standard) is obtained by the separate arithmetic summation of the positive and negative systematic errors (+ δ, - δ'). These have been estimated not to exceed

+3.3 % or -3.5 %.

The overall uncertainty (often called accuracy) is an estimate of the possible divergence of the quoted result from the true value. It is a combination of random error [t(sm)] at the 99.7% confidence limits and the worst case estimate of the systematic errors (+ δ, - δ')
The overall uncertainty is therefore calculated on the basis of + [t(sm)+δ], - [t(sm)+ δ']
and is + 5.6 % , - 5.8 % of the quoted radioactive concentration.

Decay Schemes

This standardization is based on the following assumptions of the principle nuclide, its daughter nuclides and impurities (no allowance for error in these assumptions or the assumption of quoted half-life have been included in the statement of accuracy above).

The 0.898 MeV gamma ray has an abundance of 93.4%.
The 1.836 MeV gamma ray has an abundance of 99.35%*.

Chemical Composition of Solution

Carrier content per gram of solution: 100 Micrograms of Yttrium

Other components: 0.1 M HCl

Preservative:

Remarks

* Martin, M. J., Editor. 1976 Nuclear Decay Data for Selected Radionuclides. Oak Ridge National Laboratory. ORNL-5114, VC-34c-Nuclear Physics. 54 pp.
NaI plot of Yttrium-88 is supplied.

Date Certificate Prepared: August 22, 1978

Approval Signature: _____

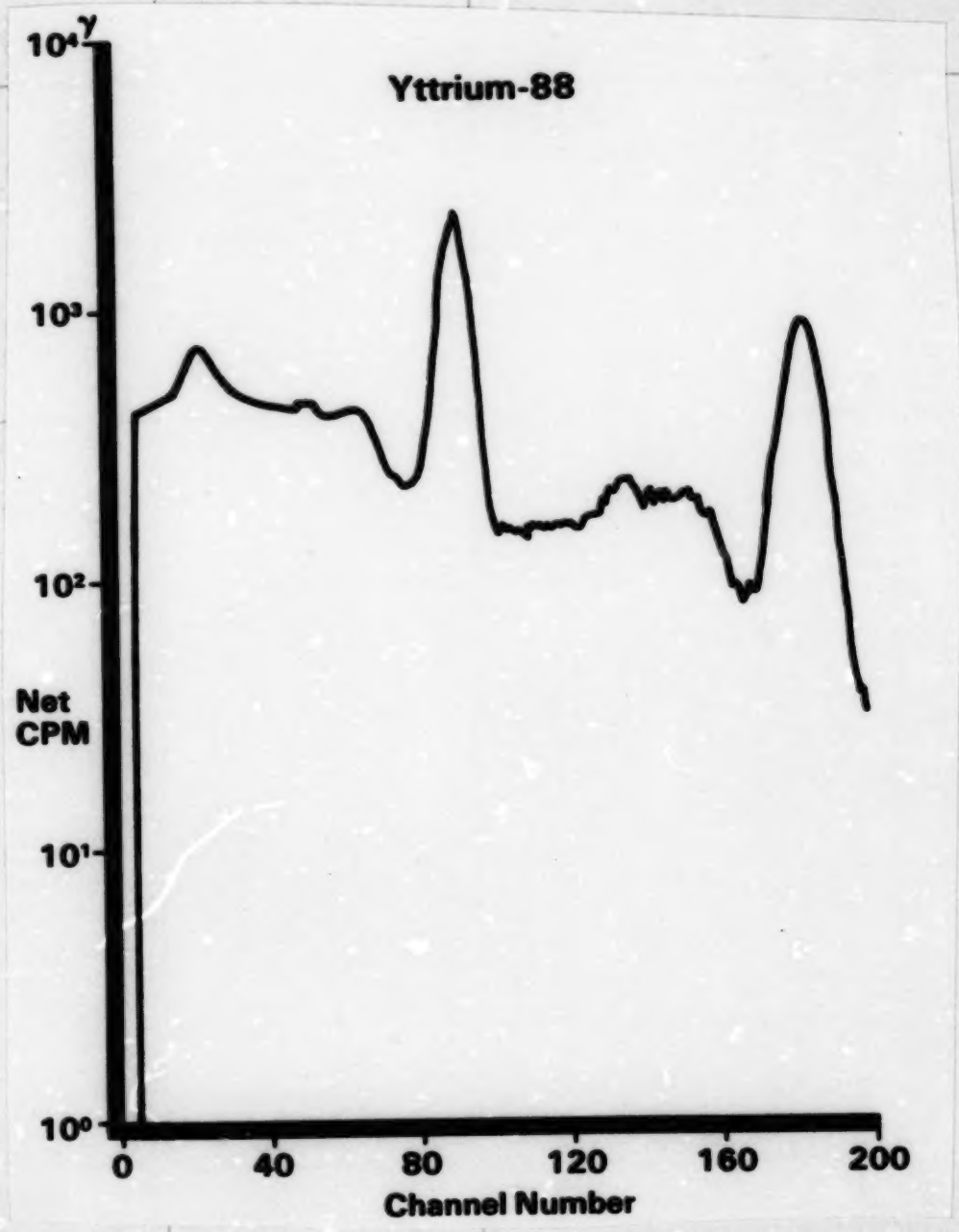
BEGIN LAST LINE OF TEXT
BOTTOM OF IMAGE AREA OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
3/8"

EPA-287 (Cin.)
(4-76)

BEGIN FIRST LINE OF TEXT HERE
TYPING GUIDE SHEET
CENTER OF PAGE
TOP OF IMAGE AREA

Certificate (continued)

DROPPED HEAD; BEGIN SECTIONS HERE



BEGIN LAST LINE OF TEXT
BOTTOM OF IMAGE AREA; OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
3/8"

EPA-287 (Cin.)
(4-76)

BEGIN FIRST LINE OF TEXT HERE
TYPING GUIDE SHEET
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEADS BEGIN SECTIONS HERE

RADIONUCLIDE REQUEST FORM

TO: QUALITY ASSURANCE DIVISION
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY
U.S. ENVIRONMENTAL PROTECTION AGENCY
P.O. Box 15027
Las Vegas, NV 89114

Please ship the calibrated samples listed below to:

Contact Person _____

Title _____

Laboratory _____

Address _____

6-1/2"

_____

Telephone _____

NRC License and/or Type(s) _____

State License Number(s) _____

NOTE: If either by-products (in quantities greater than exempt quantities) or special nuclear materials are requested, a copy of the NRC license(s) should accompany the first request.

Radionuclide Samples Desired:

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

I certify that the calibrated sample(s) requested are to be used only in this laboratory by qualified personnel for the purpose of developing or checking analytical procedures and/or for the calibration of instrumentation.

I further certify that I am authorized to receive the above listed radionuclides under the license number(s) listed above or that this laboratory is exempt from licensing regulations.

Date _____ Signature _____

Title _____

BOTTOM OF IMAGE AREA, OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
BEGIN LAST LINE OF TEXT
3/8"

EPA-287 (Cin.)
(4-76)

BEGIN FIRST LINE OF TEXT HERE
TYPING GUIDE SHEET
CENTER OF PAGE
TOP OF IMAGE AREA
DROPPED HEAD; BEGIN SECTIONS HERE
6 1/2"
8"
BEGIN LAST LINE OF TEXT
3/8"
BOTTOM OF IMAGE AREA; OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS

RADIONUCLIDE REQUEST FORM

TO: QUALITY ASSURANCE DIVISION
ENVIRONMENTAL MONITORING SYSTEMS LABORATORY
U.S. ENVIRONMENTAL PROTECTION AGENCY
P.O. Box 15027
Las Vegas, NV 89114

Please ship the calibrated samples listed below to:

Contact Person _____

Title _____

Laboratory _____

Address _____

_____

Telephone _____

NRC License and/or Type(s) _____

State License Number(s) _____

NOTE: If either by-products (in quantities greater than exempt quantities) or special nuclear materials are requested, a copy of the NRC license(s) should accompany the first request.

Radionuclide Samples Desired:

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

I certify that the calibrated sample(s) requested are to be used only in this laboratory by qualified personnel for the purpose of developing or checking analytical procedures and/or for the calibration of instrumentation.

I further certify that I am authorized to receive the above listed radionuclides under the license number(s) listed above or that this laboratory is exempt from licensing regulations.

Date _____ Signature _____

Title _____

EPA-287 (Cin.)
(4-76)